UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A ++' GRADE' UNIVERSITY)
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(25/Sept./Adp./90)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the syllabi and courses of studies for **Post Graduate Programme** in **Computer Science in M.Tech. (Specialization–AI and Data Science)** under **NEP-2020** as per details given below:-

Two Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
M. Tech. (Specialization –AI and Data Science)		
	Semester-I	December 2025, 2026 and 2027
	Semester-II	May 2026, 2027 and 2028
	Semester-III	December 2026, 2027 and 2028
	Semester-IV	May 2027, 2028 and 2029

The Syllabi of the courses are also available on the University website: www.jammuuniversity.ac.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/25/ 10246-256
Dated: 25/9/25
Copy for information and necessary action to:

1. Dean, Faculty of Mathematical Science
2. Director/Convener, Board of Studies in Computer Science and IT
3. Sr. P.A. to the Controller of Examinations
4. Director, Centre for IT Enabled services and Management, University of Jammu for information and for uploading on University Website.
5. All members of the Board of Studies
6. Joint Registrar (Evaluation/P.G. Exam.)
7. Programmer, Computer Section, Examination Wing

24/9/25
Joint Registrar (Academic)

18/9/25

Proforma for syllabi

M. Tech. - Computer Science
(Specialization – AI and Data Science)

						Course Type	Marks		Nature of course						
S. No.	Course No.	Course Title	No. of Credits	Credit Level	Credit points	Core/ Elective/ Any Other	Theory	Practical	Global	National	Regional	Skill	SWAYAM / MOOC	Vocational course	Research Project/ Summer Internship/ Dissertation
1.	P2MTTC-121	Data Structure & Algorithms	4	400		Core	100		Yes				No		
2.	P2MTTC-122	Operating System using Linux	4	400		Core	100		Yes				No		
3.	P2MTTC-123	Mathematics and Statistics for AI & Data Science	4	400		Core	100		Yes				No		
4.	P2MTTC-124	Programming for AI & Data Science	4	400		Core	100		Yes			Yes	No		
5.	P2MTPC-180	Software-Lab-I (Python /Linux/C++)	6			Core		150	Yes			Yes	No		
6.	P2MTTC-221	Artificial Intelligence	4	400		Core	100		Yes				No		
7.	P2MTTC-222	Data Visualization and Image Processing	4	400		Core	100		Yes				No		
8.	P2MTTC-223	Big Data Analytics using R	4	500		Core	100		Yes			Yes	No		
9.	P2MTTC-224	Advanced DBMS	4	500		Core	100		Yes				No		
10.	P2MTTC-225	Optimization Techniques	4	500		Core	100		Yes				No		
11.	P2MTPC-280	Software-Lab-II (MATLAB/ R/SQL)	6			Core		150	Yes			Yes	No		
12.	P2MTVC251	Machine Learning using Python	4	500		Core	100		Yes			Yes	No	Yes	

13.	P2MTTC-321	Machine Learning & Deep Learning	4	400		Core	100		Yes			Yes	No		
14.	P2MTTC-322	Research Methodology and Ethics in AI & Data Science	4	500		Core	100		Yes				No		
15.	P2MTTE-323	Natural Language Processing	4	500		Elective	100		Yes			Yes	No		
16.	P2MTTE-324	Blockchain Technology	4	500		Elective	100		Yes				No		
17.	P2MTTE-325	Pattern Recognition	4	500		Elective	100		Yes				No		
18.	P2MTTE-326	Neural Networks & Fuzzy Logic	4	500		Elective	100		Yes				No		
19.	P2MTTE-327	Applications of AI & Data Science	4	500		Elective	100		Yes				No		
20.	P2MTTE-328	Theory of Computation	4	500		Elective	100		Yes				No		
21.	P2MTTE-329	Network Security and Cryptography	4	500		Elective	100		Yes				No		
22.	P2MTTE-330	Cloud Computing and Internet of Things	4	500		Elective	100		Yes				No		
23.	P2MTMO351	MOOC/ SWAYAM Course*	4				100						Yes	No	
24.	P2MTPC-380	Software-Lab-III (Python/ IBM Modeler/Weka)	6			Core		150	Yes			Yes	No		
25.	P2MTRC-310	Dissertation (Phase-I)	2			Core		50	Yes			Yes	No		Yes
26.	P2MTRC-401	Dissertation (Phase-II)	20			Core		500	Yes			Yes	No		Yes

Revised Syllabus – 2025

(NEP-2020)

M. TECH. – Computer Science

(Specialization - AI and Data Science)

Programme Code: PGFMT002

Revised Syllabus – 2025

(NEP-2020)

M. TECH. – Computer Science
(Specialization - AI and Data Science)

UNDER

CHOICE BASED CREDIT SYSTEM

FOR THE STUDENTS

TO BE ADMITTED IN THE SESSIONS

2025-2026, 2026-2027, 2027-2028

DEPARTMENT OF COMPUTER SCIENCE & IT,

UNIVERSITY OF JAMMU

M. Tech. - Computer Science
(Specialization – AI and Data Science)

PROGRAM STRUCTURE
(Semester-Wise Distribution of Courses and Credits)

SEMESTER-I

S. No.	Course Code	Course Title	Credits	Total
1	P2MTTC-121	Data Structure & Algorithms	4	100
2	P2MTTC-122	Operating System using Linux	4	100
3	P2MTTC-123	Mathematics and Statistics for AI & Data Science	4	100
4	P2MTTC-124	Programming for AI & Data Science	4	100
5	P2MTPC-180	Software-Lab-I (Python /Linux/C++)	6	150
		TOTAL	**22**	**550**

SEMESTER-II

S. No.	Course Code	Course Title	Credits	Total
1	P2MTTC-221	Artificial Intelligence	4	100
2	P2MTTC-222	Data Visualization and Image Processing	4	100
3	P2MTTC-223	Big Data Analytics using R	4	100
4	P2MTTC-224	Advanced DBMS	4	100
5	P2MTTC-225	Optimization Techniques	4	100
6	P2MTPC-280	Software-Lab-II (MATLAB/ R/SQL)	6	150
		TOTAL	**26**	**650**
7	P2MTVC251	Machine Learning using Python	4	100

SEMESTER-III

S. No.	Course Code	Course Title	Credits	Total
1	P2MTTC-321	Machine Learning & Deep Learning	4	100
2	P2MTTC-322	Research Methodology and Ethics in AI & Data Science	4	100
3	As per course	Elective-I	4	100
4	As per course	Elective-II	4	100
5	P2MTMO351	MOOC/ SWAYAM Course*	4	100
6	P2MTPC-380	Software-Lab-III (Python/ IBM Modeler/Weka)	6	150
7	P2MTRC-310	Dissertation (Phase-I)	2	50
		TOTAL	**28**	**700**

*Student shall register for SWAYAM/MOOC in December/January of 1st Year of M.Tech. programme and this course shall be credited in 3rd semester.

SEMESTER-IV

S. No.	Course Code	Course Title	*L-T-P	Credits	Internal Marks	External Marks	Total
1	P2MTRC-401	Dissertation (Phase-II)	0-12-24	20	200	300	500
		TOTAL	**36**	**20**	**200**	**300**	**500**

*L- Lectures T- Tutorials P- Practical

Elective-I Courses	Elective-II Courses
P2MTTE-323 Natural Language Processing	P2MTTE-327 Applications of AI & Data Science
P2MTTE-324 Blockchain Technology	P2MTTE-328 Theory of Computation
P2MTTE-325 Pattern Recognition	P2MTTE-329 Network Security and Cryptography
P2MTTE-326 Neural Networks & Fuzzy Logic	P2MTTE-330 Cloud Computing and Internet of Things

TOTAL CREDITS = 96

THE CREDITS INDICATED ARE COMPUTED AS FOLLOWS:

- 1 hour Lecture/Tutorial per week = 1 credits
- 1 hour Practical per week = 0.5 credits

M. Tech.-Computer Science

(Specialization - AI and Data Science)

Semester-I

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2025, 2026, 2027

Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: P2MTTC-121

COURSE TITLE: DATA STRUCTURE & ALGORITHMS

Course Objectives & Learning Outcomes:

- To provide a solid foundation in data organization techniques and develop analytical skills for evaluating efficiency of algorithm
- To introduce advanced tree, heap and string based structures
- To equip students with core algorithm design techniques
- Students will be able to construct and manipulate advanced data structure
- Students will be able to evaluate the performance of algorithms for various algorithmic strategies

UNIT-I Data Organization

Linear and Non-linear data structures, Memory Representations, Topological Sorting, Graphs and their memory representation.

(10 Hours)

UNIT-II Advanced Search Trees

Binary Search Tree, Balanced Trees, Self-Balancing Search Trees (2-3 Trees, 2-3-4 Trees, Red-Black Trees, Splay Trees, and Finger Trees), Joining and Splitting Search Trees, Multiway Search Trees and their Applications.

(10 Hours)

UNIT-III Heaps and Strings

Array-Based Heaps, Advanced Heap Structures, Changing Keys in Heaps, Heaps of Optimal Complexity, Double-Ended and Multidimensional Heaps.
Strings and Pattern Matching Algorithms, Suffix Arrays, Suffix Trees, Tries, Dictionaries, Hashing, Collision Resolution, Applications of strings.

(10 Hours)

UNIT-IV Algorithms and Analysis

Complexity of algorithms, Performance and efficiency analysis, Mathematical Induction, Amortized Complexity, Asymptotic Notations, Master Theorem, Mathematical Analysis of Recursive and Non-recursive Algorithms, Implementation and Analysis of Sorting and Searching Techniques, Homogenous Recurrence Relations.

(10 Hours)

UNIT-V Algorithm Design Techniques

Divide-and-Conquer, Dynamic Programming, Backtracking, Greedy Algorithms.

(10 Hours)

Suggested readings/ references:

1. ***Advanced Data Structures*** *– Peter Brass, Cambridge University Press.*
2. ***Fundamentals of Data Structures in C*** *– Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, Universities Press (India) Pvt. Ltd.*
3. ***Data Structures Using C and C++*** *–Yedidiah Langsam, Moshe J. Augenstein, and Aaron M. Tenenbaum, Pearson Prentice Hall.*
4. ***Computer Algorithms*** *– Ellis Horowitz, Sartaj Sahni, and Sanguthevar Rajasekaran, Universities Press.*
5. ***Introduction to Algorithms*** *– Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, MIT Press.*

SCHEME FOR EXAMINATION

The students shall be continuously examined/evaluated during the conduct of each course of the semester. The following scheme shall be used for the evaluation of the performance of a student:

Written Test/Presentation/ Mini Project (*)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR-I (after 1 $^1/_2$ months)	25%	1 hour(**)	20
MINOR - II (after 2 $^1/_2$ months)	25% (syllabus taught during this period)	1 hour(**)	20
Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

* It shall be mandatory for the concerned teacher to conduct any 1 of the two minors (Minor-I/ Minor-II) in the mode of written exam.

**In case MINOR-I/ MINOR –II examination is conducted in the form of mini project/ presentation, the time duration shall be as per the instructions of the teacher in-charge.

Instructions for Paper Setting

MINOR-I and II: There shall be 5 short answer type questions each carrying 2 marks and 2 long answer type questions each carrying 5 marks. All questions in this test shall be compulsory.

MAJOR: There shall be 2 sections in this question paper.

- **Section- A** shall consist of 5 short answer type questions each carrying 4 marks spread over the entire syllabus. All questions in this section shall be compulsory.
- **Section-B** shall consist of total of 8 questions carrying 8 marks each. The student shall be required to attempt 5 questions out of 8. There shall be 1 question each from UNIT I and II in this paper and there shall be 2 questions each from the rest of the Units (UNIT-III, IV and V).

M. Tech.-Computer Science
(Specialization - AI and Data Science)

Semester-I

Total Marks = 100
No. of Credits = 4
Time allotted for Major Test = 3 hours
Examination to be held: December 2025, 2026, 2027
COURSE NO: P2MTTC-122
COURSE TITLE: OPERATING SYSTEM USING LINUX

Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

Course Objectives & Learning Outcomes:

- To provide a comprehensive understanding of the role and design of operating systems
- To equip students with the knowledge of core operating system functionalities
- To provide practical exposure to LINUX/UNIX environments
- Students will be able to critically analyze and evaluate the design and implementation of operating system components
- Students will be able to apply advanced LINUX/UNIX commands and scripting techniques

UNIT–I Operating System
Types and Views of Operating System, Operating System Services and System Calls, System Call Types, OS Structures (Layered Approach, Microkernels, Virtual Machines).

(10 Hours)

UNIT–II Working with LINUX/UNIX Operating System
Files and Directories, Process and User Management, Pipes and tees, Filters, Regular Expressions, Vi Editor, Shell Programming, Advanced Shell Scripting.

(10 Hours)

UNIT–III Process Management
Process Concept and Operations, Inter-process Communication, Mutual Exclusion, Process Scheduling, Process Synchronization (Critical Section, Semaphores, Monitors, Message Passing), Deadlocks (System Model, Characterization, Prevention, and Avoidance).

(10 Hours)

UNIT–IV Memory Management
Memory Allocation and Protection Techniques, Paging, Segmentation, Intel Pentium (Segmentation and Paging), Virtual memory, Demand paging, Page replacement algorithms (FIFO, Optimal, LRU, Counting based page replacement).

(10 Hours)

UNIT–V **File & I/O Management**
File System Structure and Implementation, Directory Implementation. File Allocation Methods (Contiguous allocation, Linked allocation, Indexed allocation), Disk organization and space management, Disk scheduling, Disk Management, RAID Structure.

(10 Hours)

Suggested readings/ references:

1. ***Operating System Concepts*** – *Silberschatz, Galvin, and Gagne, WSE Wiley.*
2. ***Modern Operating Systems*** – *Andrew S. Tanenbaum, Pearson Prentice Hall.*
3. ***Operating System – Concepts and Design*** – *Milan Milenkovic, McGraw Hill .*
4. ***Operating Systems*** – *A. S. Godbole, 3rd Edition, Tata McGraw Hill.*
5. ***Operating System*** – *H. M. Deitel, Pearson Publications.*
6. ***Operating Systems*** – *Madnick and Donovan, Tata McGraw Hill.*
7. ***The Complete Reference: Linux*** – *Richard L. Petersen, Tata McGraw Hill.*

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Written Test/Presentation/ Mini Project (*)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
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MINOR - II (after 2 $^1/_2$ months)	25% (syllabus taught during this period)	1 hour(**)	20
Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

* It shall be mandatory for the concerned teacher to conduct any 1 of the two minors (Minor-I/ Minor-II) in the mode of written exam.

**In case MINOR-I/ MINOR –II examination is conducted in the form of mini project/ presentation, the time duration shall be as per the instructions of the teacher in-charge.

Instructions for Paper Setting

MINOR-I and II There shall be 5 short answer type questions each carrying 2 marks and 2 long answer type questions each carrying 5 marks. All questions in this test shall be compulsory.

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- **Section- A** shall consist of 5 short answer type questions each carrying 4 marks spread over the entire syllabus. All questions in this section shall be compulsory.
- **Section-B** shall consist of total of 8 questions carrying 8 marks each. The student shall be required to attempt 5 questions out of 8. There shall be 1 question each from UNIT I and II in this paper and there shall be 2 questions each from the rest of the Units (UNIT-III, IV and V).

M. Tech.-Computer Science
(Specialization - AI and Data Science)

Semester-I

Total Marks = 100
No. of Credits = 4
Time allotted for Major Test = 3 hours
Examination to be held: December 2025, 2026, 2027
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: P2MTTC-123

COURSE TITLE: MATHEMATICS AND STATISTICS FOR AI & DATA SCIENCE

Course Objectives & Learning Outcomes:

- To build a strong mathematical foundation in logic, set theory, and functions
- To equip students with the skills to analyze real-world systems using concepts of random processes, and statistical inference.
- To develop analytical thinking for evaluating and estimating parameters in probabilistic models
- Students will be able to analyze logical statements, apply set theory, and understand function relationships in the context of computer science and data systems
- Students will be able to apply estimation techniques, hypothesis testing, and statistical analysis

UNIT-I Foundations of Logic and Combinatorics

Set theory and operations, Propositions, Logic and proof techniques, Conditional propositions, Logical equivalence, Predicates and quantifiers, Permutations and combinations.

(10 Hours)

UNIT-II Functions, Relations, and Computability

Types of functions (injective, surjective, bijective), Recursive and iterative definitions, Computable and non-computable functions, Representations of relations (matrices and digraphs), Composition and properties of relations.

(10 Hours)

UNIT-III Probability Theory and Random Variables

Sample spaces and events, Probability axioms, Joint and conditional probability, Bayes theorem, Discrete and continuous random variables, Distribution and density functions, Moments and moment generating functions, Multivariate random variables, Transformations of random variables and vectors.

(10 Hours)

UNIT-IV Stochastic Processes and Models

Random variables vs. random processes, Bernoulli and binomial processes, Ensemble and time averages, Stationarity (strict and weak sense), Ergodicity, Autocorrelation and autocovariance functions, Spectral analysis, Poisson process, Gaussian process, Martingales, Markov chains.

(10 Hours)

UNIT-V Estimation Theory and Statistical Inference

Maximum likelihood estimation, Maximum a posteriori estimation, Consistency and efficiency of estimators, Mean square error, Linear MMSE estimation, Estimation of Gaussian random vectors, Hypothesis testing, Significance level, Type 1 and Type II errors, Chi-square test, Student-t test, Normality test.

(10 Hours)

Suggested Readings/ References:

1. ***Mathematics for Computer Science*** – *Eric Lehman, F. Thomson Leighton, and Albert R. Meyer, MIT OpenCourseWare.*
2. ***Discrete Mathematics and Its Applications*** – *Kenneth H. Rosen, McGraw Hill.*
3. ***Probability and Statistics for Engineers and Scientists*** – *Ronald E. Walpole, Pearson Education.*
4. ***Statistical Inference*** – *George Casella and Roger L. Berger, Cengage Learning*
5. ***The Elements of Statistical Learning*** – *Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer*

SCHEME FOR EXAMINATION

The students shall be continuously examined/evaluated during the conduct of each course of the semester. The following scheme shall be used for the evaluation of the performance of a student:

Instructions for Paper Setting

Written Test/Presentation/ Mini Project (*)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR-I (after 1 $^1/_2$ months)	25%	1 hour(**)	20
MINOR - II (after 2 $^1/_2$ months)	25% (syllabus taught during this period)	1 hour(**)	20
Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

* It shall be mandatory for the concerned teacher to conduct any 1 of the two minors (Minor-I/ Minor-II) in the mode of written exam.

**In case MINOR-I/ MINOR –II examination is conducted in the form of mini project/ presentation, the time duration shall be as per the instructions of the teacher in-charge.

MINOR-I and II: There shall be 5 short answer type questions each carrying 2 marks and 2 long answer type questions each carrying 5 marks. All questions in this test shall be compulsory.

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- **Section- A** shall consist of 5 short answer type questions each carrying 4 marks spread over the entire syllabus. All questions in this section shall be compulsory.
- **Section-B** shall consist of total of 8 questions carrying 8 marks each. The student shall be required to attempt 5 questions out of 8. There shall be 1 question each from UNIT I and II in this paper and there shall be 2 questions each from the rest of the Units (UNIT-III, IV and V).

M. Tech.-Computer Science
(Specialization - AI and Data Science)

Semester-I

Total Marks = 100
No. of Credits = 4
Time allotted for Major Test = 3 hours
Examination to be held: December 2025, 2026, 2027
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks
COURSE NO: P2MTTC-124
COURSE TITLE: PROGRAMMING FOR AI & DATA SCIENCE

Course Objectives & Learning Outcomes:

- To develop a strong foundation in Python
- To enable students to apply statistical, analytical, and machine learning techniques
- To familiarize learners with practical tools and technologies for large-scale data processing
- Students will be able to develop skills for handling and visualizing data using core libraries
- Students will be able to apply machine learning algorithms including regression, classification, and clustering

Unit-I Programming Fundamentals and Data Handling

Python Basics, Operators and Complex Data Types, Control Structures, Working with Modules, Functions, String operations (string slicing, immutability, string functions and string module).

(10 Hours)

Unit-II Data Structures and Data Handling

Lists, tuples, sets, dictionaries, File handling (CSV, JSON), Exception handling, Working with libraries (os, sys, math), creating plots (line, bar, histogram, scatter, heatmaps).

(10 Hours)

Unit- III Data Analysis and visualization using Python Libraries

NumPy (Arrays, linear algebra, and numerical computations), Pandas (DataFrames, data cleaning, manipulation, and analysis), Data visualization (Matplotlib and Seaborn for creating charts, graphs, heatmaps and other visualizations).

(10 Hours)

UNIT-IV Classification and Clustering Techniques

Supervised learning, Regression (linear, polynomial), classification (logistic regression, decision trees, random forests), and other algorithms.
Unsupervised learning, Clustering (K-means, hierarchical), dimensionality reduction (PCA).

(10 Hours)

UNIT-V Handling Big Data

Big Data Integration, handling large datasets in Python, (with TensorFlow and PyTorch), Big data analysis, Cloud Integration, Google Colab for scalable computation

(10 Hours)

Suggested Readings/ References:

1. ***Python for Data Analysis*** *– Wes McKinney, O'Reilly Media.*
2. ***Data Analytics Using Python****, Bharti Motwani, Wiley India*
3. ***Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*** *, Aurélien Géron, O'Reilly Media.*
4. ***Python for Data Science*** *– S. Parthasarathy, S. S. G. Chandra, and V. S. Srinivasan, 1st Edition, Wiley India.*
5. ***Python Data Science Handbook*** *– Jake VanderPlas, O'Reilly Media.*

SCHEME FOR EXAMINATION

The students shall be continuously examined/evaluated during the conduct of each course of the semester. The following scheme shall be used for the evaluation of the performance of a student:

Written Test/Presentation/ Mini Project (*)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR-I (after 1 $^1/_2$ months)	25%	1 hour(**)	20
MINOR - II (after 2 $^1/_2$ months)	25% (syllabus taught during this period)	1 hour(**)	20
Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

* It shall be mandatory for the concerned teacher to conduct any 1 of the two minors (Minor-I/ Minor-II) in the mode of written exam.

**In case MINOR-I/ MINOR –II examination is conducted in the form of mini project/ presentation, the time duration shall be as per the instructions of the teacher in-charge.

Instructions for Paper Setting

MINOR-I and II: There shall be 5 short answer type questions each carrying 2 marks and 2 long answer type questions each carrying 5 marks. All questions in this test shall be compulsory.

MAJOR: There shall be 2 sections in this question paper.

- **Section- A** shall consist of 5 short answer type questions each carrying 4 marks spread over the entire syllabus. All questions in this section shall be compulsory.
- **Section-B** shall consist of total of 8 questions carrying 8 marks each. The student shall be required to attempt 5 questions out of 8. There shall be 1 question each from UNIT I and II in this paper and there shall be 2 questions each from the rest of the Units (UNIT-III, IV and V).

M. Tech.-Computer Science
(Specialization - AI and Data Science)
Semester-I

Total Marks = 150
No. of Credits = 6
Examination to be held: December 2025, 2026, 2027
Internal Evaluation = 75 Marks
External Evaluation = 75 Marks
COURSE NO: P2MTPC-180
COURSE TITLE: SOFTWARE-LAB-I (PYTHON / LINUX/ C++)

This Practical course shall be primarily based on Python/Linux/C++. The course carries 150 marks distributed as follows:

Practical			Marks	
Internal Evaluation	I	Program Implementation & Viva-Voce	65	75
	II	Practical File	10	
External Evaluation				75
Total				**150**

Internal Evaluation

Guidelines for internal Assessment of practical courses

- Performance of the students will be evaluated based on a comprehensive system of continuous evaluation.
- For each practical course, students will be given regular assignments by the concerned practical teacher(s).
- The implementation of assignments will be assessed & evaluated and viva-voce will be conducted at least once in every fifteen days and the students shall be awarded based on their performance.
- Record of the Internal evaluation shall be maintained regularly by the concerned teacher(s).
- At the end of the semester all the awards of the students shall be consolidated for the purpose of preparing the final award of the Internal Evaluation.

External Evaluation

The External practical evaluation shall be conducted by an external examiner. The internal practical teacher incharge shall coordinate the conduct of the external practical examination.

M. Tech.-Computer Science
(Specialization - AI and Data Science)

Semester-II

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: May 2026, 2027, 2028
COURSE NO: P2MTTC-221
COURSE TITLE: ARTIFICIAL INTELLIGENCE

Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

Course Objectives & Learning Outcomes:

- To understand core AI concepts, problem-solving approaches, and lifecycle of expert systems
- To study logic-based, structural, and semantic methods for encoding and using knowledge effectively
- To explore the architecture and coordination mechanisms of multi-agent systems and genetic algorithms
- Students will be able to demonstrate advanced conceptual and practical knowledge of AI systems and expert system architectures
- Students will be able to represent and reason about knowledge using formal logic, semantic models, and intelligent inference strategies

UNIT- I AI and Expert System Design

Artificial Intelligence (AI), Turing Machine, Turing Test and Rational Agent Approaches, State Space Representation of Problems, Game Playing, Min-Max Search, Alpha Beta Cutoff Procedures.
Expert System Life Cycle, Study of existing expert systems like MYCIN and DENDRAL.

(10 Hours)

UNIT-II Searching Techniques

Heuristic Search techniques -Hill Climbing, Best first search: A* algorithm, Problem Reduction (AND-OR graph, The AO* Algorithm) Constraint satisfaction problem: Components, Types, Representation, Solving Constraint satisfaction problem.

(10 Hours)

UNIT-III Knowledge Representation

Knowledge Representation Structures: Prepositional Logic, First Order Predicate Logic, CNF, DNF, Prenex Normal Form, Resolution, Unification, Inference Mechanisms Semantic Nets, Frames, Scripts, conceptual dependences, Procedural & Declarative knowledge, Reasoning, Uncertainty.

(10 Hours)

UNIT- IV Multi Agent Systems and Genetic Algorithms

Agents vs. Objects, Agents in Expert Systems, Structure of Multiagent System, Semantic Web, Agent Communication, Knowledge Sharing using Ontologies, Agent Development Tools.
Genetic Algorithms (GA) (Encoding Strategies, Genetic Operators, Fitness Functions and GA Cycle), Problem Solving using GA.

(10 Hours)

UNIT-V Robotics

Components and Architecture, Configuration spaces, Navigation and motion planning, AI based programming Tools

(10 Hours)

Suggested readings/ references:

1. ***Artificial Intelligence: A Modern Approach*** - *Russell, S. J. & Norvig, P., Pearson*
2. ***Artificial Intelligence: Building Intelligent Systems*** - *Meshram, B. B. & Biradar, S. R., TechKnowledge Publications*
3. ***AI Rising: India's Artificial Intelligence Growth Story*** - *D'Monte, L. & Kolla, J. N., HarperCollins India*
4. ***Deep Utopia: Life and Meaning in a Solved World*** - *Bostrom, N., Allen Lane*
5. ***Introduction to Robotics: Mechanics and Control*** - *Craig, J. J., Pearson Education*

SCHEME FOR EXAMINATION

The students shall be continuously examined/evaluated during the conduct of each course of the semester. The following scheme shall be used for the evaluation of the performance of a student:

Written Test/Presentation/ Mini Project (*)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR-I (after 1 $^1/_2$ months)	25%	1 hour(**)	20
MINOR - II (after 2 $^1/_2$ months)	25% (syllabus taught during this period)	1 hour(**)	20
Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
Major Exam(after 4 months)	100%	3 hours	60
Total			**100**

* It shall be mandatory for the concerned teacher to conduct any 1 of the two minors (Minor-I/ Minor-II) in the mode of written exam.

**In case MINOR-I/ MINOR –II examination is conducted in the form of mini project/ presentation, the time duration shall be as per the instructions of the teacher in-charge.

Instructions for Paper Setting

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MAJOR: There shall be 2 sections in this question paper.

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M. Tech. - Computer Science
(Specialization - AI and Data Science)

Semester-II

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: May 2026, 2027, 2028

Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: DATA VISUALIZATION AND IMAGE PROCESSING
COURSE TITLE: P2MTTC-222

Course Objectives & Learning Outcomes:

- Understand and apply the fundamental design principles of data visualization
- To equip students with knowledge of advanced visualization techniques
- To enable students to apply restoration and morphological processing techniques
- Students will be able to implement image segmentation and compression methods
- Students will be able to apply data visualization techniques to effectively explore complex datasets

UNIT- I Data Representation and Visualization

Data Visualization Principles, Visual Encoding, Visualizing numerical quantities, distributions, and proportions, Time Series Visualization, Tools and Implementation.

(10 Hours)

Unit-II Advanced Visualization and Analytics

Real-time visualizations, Geospatial Data Visualization, Matrix plots and 3D plots, Graphs and Networks, Embedding Planar Graphs, Tree Maps, Principal Component Analysis, Multidimensional Scaling, Packing.

(10 Hours)

Unit-III Image Representation and Enhancement

Digital image process, image formation and representation, image sampling and quantization, color models, image enhancement in spatial and frequency domain, image restoration.

(10 Hours)

Unit-IV Image Restoration and Morphological processing

Restoration process, Noise models and Noise reduction, Linear and nonlinear filtering techniques, inverse filtering.

Morphological Operations, Algorithms (Boundary extraction, Region filling and Skeletonization, Convex hull and Thinning)

(10 Hours)

Unit-V Image Segmentation and Compression

Segmentation basics, Thresholding techniques, Edge-based and Region-based segmentation, Region growing and region splitting, Watershed segmentation, Morphological segmentation,

Lossless and Lossy compression strategies, Image compression standards, Image quality assessment metrics.

(10 Hours)

Suggested readings/ references:

1. ***Digital Image Processing*** *- R. C. Gonzalez & R. E. Woods, Pearson*
2. ***Image Processing: The Fundamentals*** *- M. Petrou & C. Petrou, Wiley.*
3. ***The Visual Display of Quantitative Information*** *- Edward R. Tufte, Graphics Press*
4. ***Fundamentals of Data Visualization*** *- Claus O. Wilke, O'Reilly*
5. ***Digital Image Processing*** *- Jayaraman, S., Esakkirajan & T. Veerakumar, Tata McGraw-Hill Education*

SCHEME FOR EXAMINATION

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Written Test/Presentation/ Mini Project (*)	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam(after 4 months)	100%	3 hours	60
Total			**100**

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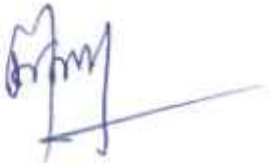

M. Tech. -Computer Science
(Specialization - AI and Data Science)

Semester-II

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: May 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks
COURSE NO: P2MTTC-223
COURSE TITLE: BIG DATA ANALYTICS USING R

Course Objectives & Learning Outcomes:

- To develop a strong foundation in big data concepts, Hadoop architecture, and its ecosystem.
- To enable efficient data handling, manipulation, and visualization using R.
- To be able to manage and process large datasets using Hadoop and R.
- Students will be able to apply statistical and analytical methods in R for data exploration and big data integration
- Students will be able to build and evaluate machine learning models for classification, clustering, and regression.

UNIT-I Big data and HADOOP

Big Data Analytics, Analytical Architecture, Challenges and need of big data frameworks.
Hadoop, Hadoop Distributed File System (HDFS), file storage and data flow in Hadoop. Hadoop Ecosystem, Hadoop ecosystem in Big Data, Pig, Hive, HBase.

(10 Hours)

UNIT-II Hadoop File Management and MapReduce

HDFS file read/write operations, command-line interface, Hadoop file system interfaces, data ingestion with Flume and Sqoop, Hadoop archives, Hadoop I/O (compression, serialization, Avro, Parquet, ORC).
Map Reduce Architecture, Types and Formats, Features, Job Execution, Scheduling, and Data Flow.

(10 Hours)

UNIT-III Data Handling and Statistical Analysis in R

R Programming Basics, Data Structures, Data pre-processing and handling techniques, importing/exporting data (CSV, JSON, databases), data visualization, Measures of Central Tendency and Dispersion, Covariance and Correlation.

(10 Hours)

UNIT- IV R for Big Data and Hadoop

Big Data Tools in R: RHadoop, SparkR & HDFS, Parallel and Distributed Computing, Accessing Hadoop Data in R (using Hive, Pig, and HBase), R Integration with the Hadoop Ecosystem, Analyzing Large-Scale Datasets using R.

(10 Hours)

UNIT-V Advanced Analytics in R

Linear and Logistic Regression, Classification Algorithms (Support Vector Machines (SVM), Naïve Bayes Classifier, Logistic Regression, Decision Trees), Clustering Techniques(K-Means Clustering, Hierarchical Clustering), Model Evaluation and Validation, Correlation matrices and heatmaps.

(10 Hours)

Suggested readings/ references:

1. ***R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*** - *Wickham, H. & Grolemund, G., O'Reilly Media*
2. ***Big Data Analytics with R and Hadoop*** - *Prasad, A., Packt Publishing*
3. ***Machine Learning with R*** - *Lantz, B., Packt Publishing*
4. ***Big Data Analytics*** - *Rai, K. & Saxena, P., McGraw Hill Education*
5. ***Hadoop: The Definitive Guide*** - *Tom White, O'Reilly Media*
6. ***Beginning R: The Statistical Programming Language*** - *Mark Gardener, Wiley*

SCHEME FOR EXAMINATION

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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

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**In case MINOR-I/ MINOR –II examination is conducted in the form of mini project/ presentation, the time duration shall be as per the instructions of the teacher in-charge.

Instructions for Paper Setting

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MAJOR: There shall be 2 sections in this question paper.

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M. Tech-Computer Science
(Specialization - AI and Data Science)

Semester-II

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: May 2026, 2027, 2028
COURSE NO: P2MTTC-224
COURSE TITLE: ADVANCED DBMS

Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

Course Objectives & Learning Outcomes:

- To Understand and Implement Database Normalization Techniques
- To Evaluate Distributed Database Systems and
- To Explore and Implement Object-Based Database Concepts
- Students will be able to utilize Data Warehousing and Mining Techniques
- Able to work with distributed and object based databases by using data mining techniques

UNIT-I Relational Database Theory and Operations

Data models (Hierarchical, Network Data Model and Entity Relationship Model), Relational Database Design using ER to Relational Mapping, Relational Algebra and Relational Calculus Concepts, Joins, Queries using Relational Algebra and Calculus

(10 Hours)

UNIT -II Normalization

Keys, Functional Dependencies, Inference rules, Covers, Equivalence of Functional Dependencies, Multivalued Dependencies, Normalization and Normal Forms, Join Dependency, Domain Key Normal Form

(10 Hours)

UNIT -III Distributed Databases

Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases, Availability, Distributed Query Processing, Heterogeneous Distributed Databases, Cloud-Based Databases, Directory Systems.

(10 Hours)

UNIT - IV Data Warehousing and Mining

Decision-Support Systems, Data Warehousing, Data Mining, Classification, Association Rules, Types of Associations, Clustering, Forms of Data Mining

(10 Hours)

Unit-V Object-Based Databases

Complex Data Types, Structured Types and Inheritance in SQL, Table Inheritance, Array and Multiset Types in SQL, Object-Identity and Reference Types in SQL, Implementing O-R Features, Persistent Programming Languages, Object-Relational Mapping, Object- Oriented versus Object-Relational

(10 Hours)

Suggested Readings/ References:

1. ***Database System Concepts*** *– Abraham Silberschatz, Henry F. Korth, and S. Sudarshan – McGraw-Hill*
2. ***Fundamentals of Database Systems*** *– Ramez Elmasri and Shamkant B. Navathe – Pearson*
3. ***Principles of Distributed Database Systems*** *– M. Tamer Özsu and Patrick Valduriez – Springer*
4. ***Data Mining: Concepts and Techniques*** *– Jiawei Han, Micheline Kamber, and Jian Pei – Morgan Kaufmann*
5. ***Object-Oriented Database Systems: Approaches and Architectures*** *– C. S. R. Prabhu – PHI Learning*

SCHEME FOR EXAMINATION

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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam(after 4 months)	100%	3 hours	60
Total			**100**

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M. Tech.-Computer Science
(Specialization - AI and Data Science)

Semester-II

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: May 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: P2MTTC-225

COURSE TITLE: OPTIMIZATION TECHNIQUES

Course Objectives & Learning Outcomes:

- To understand optimization theories and algorithms for various problems
- To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems
- To equip students with strategies for solving sequencing and replacement problems
- Student will be able to formulate real-world problems into linear programming models using constraints and objective functions
- Student will be able to interpret sensitivity analysis and duality concepts for better decision-making in business and engineering problems

UNIT-I Linear programming (LP)

Optimization Techniques (Limitation and Applications), Linear Programming Problem formulation, LP solutions.

Simplex Method, Two Phase Simplex Method, Multiple, Unbounded and Infeasible Solution, Dual Simplex Approach, Sensitivity and Duality Analysis in LP.

(10 Hours)

UNIT-II Transportation Problem (TP)

Structure and Formulation, Procedure for TP, Methods for Finding Initial Solution and Optimality, Unbalanced Maximization, Degeneracy, Trans shipment in TP, Assignment Problem (Approach, Procedure and Maximization), Unbalanced Assignment Problems.

Network Analysis and representation, Project Planning and Control with PERT and CPM.

(10 Hours)

UNIT-III Sequencing problems

Processing N-Jobs (using Two, Three, M Machines).

Replacement decisions (Replacement of Items that Deteriorate with Time -With and without Change in Money Value, Staff Replacement Problem).

(10 Hours)

UNIT-IV Integer and Dynamic programming

Integer Programming, Formulation Techniques, Unimodularity, Cutting Plane Method, Branch and Bound Method, Dynamic programming.

(10 Hours)

UNIT-V Nonlinear programming

Solution of Non-Linear Programming, Convex and Concave Functions, Quadratic and Separable Programming, Kuhn Tucker Conditions for Constraint Optimization.

(10 Hours)

Suggested readings/ references:

1. ***Introduction to Operations Research*** – *Hillier, F. S., & Lieberman, G. J., McGraw-Hill Education*
2. ***Operations Research: An Introduction*** – *Taha, H. A. , Pearson*
3. ***Algorithms for Optimization*** – *Kochenderfer, M. J., & Wheeler, T. A. , MIT Press*
4. ***Optimization Techniques and Applications with Examples*** – *Yang, X.-S*
5. ***Operations Research: Theory and Applications*** – *Sharma, J. K. , Macmillan Publishers India*
6. ***Operations Research: Optimization Techniques*** – *Kapoor, V. K. , Sultan Chand & Sons*

SCHEME FOR EXAMINATION

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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

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M. Tech.-Computer Science
(Specialization - AI and Data Science)
Semester-II

Total Marks = 150
No. of Credits = 6
Examination to be held: May 2026, 2027, 2028
Internal Evaluation = 75 Marks
External Evaluation = 75 Marks
COURSE NO: P2MTPC-280
COURSE TITLE: SOFTWARE-LAB-II (MATLAB/ R/ SQL)

This Practical course shall be primarily based on MATLAB/ R/ SQL. The course carries 150 marks distributed as follows:

Practical			Marks	
Internal Evaluation	I	Program Implementation & Viva-Voce	65	75
	II	Practical File	10	
External Evaluation				75
Total				**150**

Internal Evaluation

Guidelines for internal Assessment of practical courses

- Performance of the students will be evaluated based on a comprehensive system of continuous evaluation.
- For each practical course, students will be given regular assignments by the concerned practical teacher(s).
- The Implementation of assignments will be assessed & evaluated and viva-voce will be conducted at least once in every fifteen days and the students shall be awarded based on their performance.
- Record of the Internal evaluation shall be maintained regularly by the concerned teacher(s).
- At the end of the semester all the awards of the students shall be consolidated for the purpose of preparing the final award of the Internal Evaluation.

External Evaluation

The External practical evaluation shall be conducted by an external examiner. The internal practical teacher incharge shall coordinate the conduct of the external practical examination.

VOCATIONAL COURSE

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: May 2026, 2027, 2028

Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: P2MTVC251

COURSE TITLE: MACHINE LEARNING USING PYTHON

Course objectives & learning outcomes:

- To introduce students to state-of-the-art methods and modern programming tools for data analysis
- To understand complexity of Machine Learning algorithms and their limitations
- To understand modern notions in data analysis-oriented computing
- Student will be able to implement various packages of Python Library
- Student will be able to perform experiments in Machine Learning using real-world data using Python

UNIT–I Machine Learning

Supervised, unsupervised, semi supervised and reinforcement learning, Steps in the design of learning system, Training and testing, Cross Validation, Feature Reduction/Dimensionality reduction, Performance prediction parameters, Applications of machine learning.

(10 Hours)

UNIT–II Classification and Clustering Algorithms

Supervised Learning, Labelled data, Classification, and its algorithms (Naive-Bayes classifier, Decision trees, Support vector machines), Principal component analysis (Eigen values, Eigen vectors, Orthogonality).

Unsupervised Learning, Unlabelled data, Clustering, and its types (Hierarchical, Fuzzy, Density based, Distance based, Model based, K-means clustering, Nearest Neighbour).

(10 Hours)

UNIT–III Genetic Algorithm and Deep Learning

Introduction, Q learning, Temporal Difference Learning, Learning from Examples, Reward Hypothesis. Genetic algorithm (Steps involved in genetic algorithm, Applications of genetic algorithm). Deep learning concepts, Tools and Platforms.

(10 Hours)

UNIT–IV Python Programming

Data types, variables, and operators, Complex data types (strings, tuples, named tuples, lists, sets, frozen sets, dictionaries, iteration and copying of collections and arrays), Program flow control, Conditional statements, Loops (ranges, strings, lists, and dictionaries), Exception handling.

(10 Hours)

UNIT–V Machine Learning and Deep Learning with Python

Classification and Prediction, Text Identification, Scikit Learn, Python libraries: Pandas, NumPy, Matplotlib etc.

Deep learning (Tools, Libraries), Implementation of Deep learning model on images.

(10 Hours)

Suggested readings/ references:

1. ***Machine Learning: A Probabilistic Perspective-*** *Kevin Murphy, MIT Press*
2. ***Pattern Recognition and Machine Learning-****Christopher M. Bishop, Springer*
3. ***Understanding Machine Learning: From Theory to Algorithms-*** *Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press*
4. ***Neural Networks and Learning Machines-*** *Simon Haykin, Prentice Hall*
5. ***Fuzzy Logic with Engineering Applications,-****Timothy J. Ross, John Wiley & Sons*

SCHEME FOR EXAMINATION

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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

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M. Tech.–Computer Science
(Specialization-AI and Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: P2MTTC-321

COURSE TITLE: MACHINE LEARNING & DEEP LEARNING

Course Objectives & Learning Outcomes:

- To understand the fundamental concepts of machine learning and deep learning
- To explore the process of building and evaluating machine learning models
- To gain practical knowledge of various supervised and unsupervised learning algorithms and their real-world applications.
- Students will be able to build and evaluate machine learning models using key concepts like cross-validation and performance prediction parameters
- Students will be able to analyze and tune deep learning models using hyperparameters to improve performance

UNIT- I Machine Learning

Supervised, Unsupervised, Semi supervised and Reinforcement learning, Design of Learning system, Training and testing, Cross Validation, Performance prediction parameters, Applications of machine learning.

(10 Hours)

UNIT-II Supervised and Unsupervised Learning Techniques

Labelled data, Classification algorithms (Nearest Neighbour, Naive-Bayes classifier, Decision trees, Linear regression, Logistic regression, Support vector machines), Principal component analysis, Unlabelled data, Clustering techniques (Partition, Hierarchical K-means).

UNIT-III Deep Learning

Deep Learning vs Machine Learning, Deep Learning Frameworks, Tools and Platforms (Tensor flow, Keras libraries), Applications and challenges of Deep learning.

(10 Hours)

UNIT-IV Deep Learning Hyper parameters

Activation functions, Loss functions, Cross-Entropy, over fitting, under fitting, and regularization techniques, Optimization techniques (SGD, Adam, RMSprop), Gradient Descent Rule, vanishing gradient problem and solution.

(10 Hours)

UNIT-V Convolutional Neural Networks (CNN)

Mathematical Foundation, CNN layers (Convolution, Kernel, pooling, and padding operations), problems and solutions of under fitting and over fitting, CNNs in computer vision (Image classification, object detection).

(10 Hours)

Suggested readings/ references:

1. ***Deep Learning*** *- Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press.*
2. ***Deep Learning: Methods and Applications*** *- Li Deng and Dong Yu, Now Publishers.*
3. ***Deep Learning with Python****- François Chollet, Manning Publications.*
4. ***Neural Networks and Deep Learning*** *- Michael Nielsen, Determination Press.*
5. ***Building Intelligent Systems Using Machine Learning and Deep Learning*** *- Abhaya Kumar Sahoo, Chittaranjan Pradhan, Bhabani Shankar Prasad Mishra, and Brojo Kishore Mishra, Nova Science Publishers.*

SCHEME FOR EXAMINATION

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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

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Instructions for Paper Setting

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MAJOR: There shall be 2 sections in this question paper.

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M. Tech.-Computer Science
(Specialization-AI and Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: P2MTTC-322

COURSE TITLE: RESEARCH METHODOLOGY AND ETHICS IN AI & DATA SCIENCE

Course Objectives & Learning Outcomes:

- To introduce the fundamentals of research methodology applicable to AI and Data Science
- To develop the ability to design and conduct ethical and effective research studies
- Equip students with knowledge of data collection methods, sampling techniques, and data analysis strategies
- Students will be able to identify potential harms of data collections, aggregation, and analysis typically found in applied data science contexts.
- Students will be able to evaluate and discuss Legal, Regulatory, and Social Implications of Data Science

UNIT-I Research Methodology

Research objectives, Types of research, Research and Scientific Methods in research, Criteria of Good Research, Research Process and Problem Formulation, Hypothesis Development, Research Design (Exploratory, Descriptive, Experimental).

(10 Hours)

UNIT-II Data Collection & Analysis

Sampling Techniques and Sample Size Determination, Primary vs Secondary Data, Data Collection Methods (Quantitative and Qualitative Methods), Statistical Analysis (Descriptive and Inferential), Literature Review (Tools and Techniques -Mendeley, Zotero), Research Paper Structure, Writing Proposals and Thesis.

(10 Hours)

UNIT-III Ethics in AI and Data Science

Ethics and Morality in Technology, Ethical issues in AI and Data Science, Historical Perspective, Ethical principles, and codes of conduct in research, Data Ethics and Its Relevance, Responsible data collection and data usage, Privacy concerns in data science, Legal and Regulatory Framework.

(10 Hours)

UNIT-IV Data Privacy and Principles

Data privacy concepts, Anonymization and Pseudonymization, Data Privacy Principles, Security Measures in AI and Data Science, Data encryption and secure storage, preventing data breaches and securing sensitive information, Cybersecurity frameworks for data security, Risk Management, Identifying and mitigating risks in handling data, Ethical Implications of Data Sharing and Ownership.

(10 Hours)

UNIT-V Ethical Decision-Making

Bias and Fairness in Algorithms, identifying biases in data and models, Fairness metrics in machine learning models, Case studies on biased algorithms (e.g., bias in facial recognition systems), Transparency in Data Science Models, Ethical consequences of AI decision-making, Social and Economic Impacts of Data Science, Regulating AI and Automation.

(10 Hours)

Suggested readings/ references:

1. ***Ethics of Artificial Intelligence*** *-Paula Boddington, Springer.*
2. ***Real World AI Ethics for Data Scientists****- Nachshon Goltz & Tracey Dowdeswell. Routledge.*
3. ***Research Methodology: Methods and Techniques*** *-C.R. Kothari, New Age International Publisher.s*
4. ***Data Science Ethics: Concepts, Techniques, and Cautionary Tales*** *- David Martens, Oxford University Press.*
5. ***Fundamental of Research Methodology and Statistics****-Y.K. Singh, New Age International Publishers.*

SCHEME FOR EXAMINATION

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MINOR- II (after2 $^1/_2$months)	25% (syllabus taught during this period)	1 hour(**)	20
Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

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- **Section-B** shall consist of total of 8 questions carrying 8 marks each. The student shall be required to attempt 5 questions out of 8. There shall be 1 question each from UNIT I and II in this paper and there shall be 2 questions each from the rest of the Units (UNIT-III, IV and V).

M. Tech.-Computer Science
(Specialization-AI and Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks
COURSE NO: P2MTTE-323
COURSE TITLE: NATURAL LANGUAGE PROCESSING

Course Objectives & Learning Outcomes:

- To provide students with a foundational understanding of the essential aspects of Natural Language Processing (NLP)
- To introduce students to different types of language models (N-gram models) and familiarize them with various phases involved in NLP
- To familiarize students with modern NLP architectures like GPT and BERT, along with the processes of pre-training, fine-tuning, and applying these models in real-world applications
- Students will be able to understand and implement syntactic analysis techniques
- Students will be able to pre-train, fine-tune, and apply large language models to solve domain-specific problems

UNIT-I Aspects of NLP

NLP Aspects, The Ambiguity of Language: Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cross entropy, some early natural language processing systems like ELIZA, LUNAR, SHRDLU.

(10 Hours)

UNIT-II Language Modeling and NLP Phases

N-gram Language Models: The role of language models; Simple N-gram models. Estimating parameters and smoothing; evaluating language models.

Various phases of natural language processing: phonological analysis, morphological analysis, lexical analysis, syntactic analysis, semantic analysis, pragmatic and discourse analysis, parsing techniques, comparison of various parsing techniques.

(10 Hours)

UNIT-III Syntactic Analysis

Word class and part of speech tagging, Grammar formalisms and tree banks, Efficient parsing for context-free grammars (CFGs), problems of top down and bottom-up parser, left recursion, Neural shift-reduce dependency parsing, ambiguity

(10 Hours)

UNIT-IV Semantic Analysis

Syntax driven semantic analysis, lexical semantics and word-sense disambiguation, use of knowledge for language analysis, representation of knowledge for language analysis, first order predicate calculus, concept of pragmatic and discourse analysis, Compositional semantics; Semantic Role Labeling and Semantic Parsing.

(10 Hours)

UNIT-V Large Language Models

Generative Pre-trained Transformer (GPT) and Bidirectional Encoder Representations from Transformers (BERT), Pre-training Language Models, Exploration of model architectures and training strategies, Techniques for fine-tuning pre-trained language models, Applications of fine-tuned models in specific domains. Ethical Considerations in NLP, Artificial Intelligence (AI) in NLP applications.

(10 Hours)

Suggested Readings/ References:

1. ***Natural Language Understanding*** - *James Allen,Tata McGraw-Hill Publishing House.*
2. ***Speech and Language Processing*** - *Daniel Jurafsky and James H. Martin, PHI Publication.*
3. ***Natural Language Understanding*** - *James Allen, The Benjamin/Cummings Publishing Company Inc.*
4. ***Machine Learning*** - *Tom M. Mitchell, McGraw Hill.*
5. ***Elements of Information Theory*** - *T. M. Cover and J. A. Thomas, Wiley.*
6. ***Statistical Language Learning*** - *Eugene Charniak, The MIT Press.*

SCHEME FOR EXAMINATION

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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

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M. Tech.-Computer Science
(Specialization - AI and Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: P2MTTE-324

COURSE TITLE: BLOCKCHAIN TECHNOLOGY

Course Objectives & Learning Outcomes:

- To develop a deep understanding of blockchain architecture and crypto currencies
- To explore core security mechanisms and consensus protocols in blockchain
- Enable hands-on proficiency with blockchain platforms and smart contract development
- Students will be able to demonstrate a comprehensive understanding of blockchain technology, decentralized systems, and the architecture of crypto currencies
- Students will be able to evaluate and apply blockchain-based solutions to real-world problems in domains

UNIT-I Blockchain and Decentralized Systems

Blockchain, Growth of blockchain technology, Distributed systems, Bitcoin, Types of blockchain. Decentralization (Methods of decentralization, Routes of decentralization, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized organizations, platforms for decentralization).

(10 Hours)

UNIT-II Fundamentals of Blockchain and Cryptocurrencies

Blockchain Architecture, Versions, Variants, Use cases, Blockchain vs shared Database, Introduction to cryptocurrencies, Types, Applications. Bitcoins (Introducing Bitcoin, Bitcoin digital keys and addresses, Transactions, Blockchain mining). Alternative Coins. Limitations of Bitcoin.

(10 Hours)

UNIT-III Core Security and Consensus Mechanisms in Blockchain

Concept of Hashing, Cryptography, Double Spending, Consensus Protocols (Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Practical Byzantine Fault Tolerance (PBFT)).

(10 Hours)

UNIT-IV Blockchain Platforms and Smart Contract Development

Blockchain Platforms- Public and Permissioned (Ethereum, Solidity - Language of Smart Contracts, Installing Solidity &Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts), General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address), Hyperledger Fabric, Architecture and Components.

(10 Hours)

UNIT-V Blockchain Applications and Integration with Emerging Technologies

Blockchain Applications and Case Study: Supply Chain Management, Decentralized Identity Management, Healthcare, E-Governance, Data Security, and Integrity.
Blockchain and allied Technologies: Blockchain and AI, ML, IoT, Cloud Computing.

(10 Hours)

Suggested readings/ references:

1. ***Blockchain Basics: A Non-Technical Introduction in 25 Steps*** - *Daniel Drescher, Springer.*
2. ***Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World*** - *Don Tapscott and Alex Tapscott, Penguin.*
3. ***Blockchain Technology: Concepts and Applications*** - *Kumar Saurabh and Ashutosh Saxena, Wiley Publications.*
4. ***Mastering Blockchain*** -*Imran Bashir, Packt.*
5. ***Blockchain Technology: Algorithms and Applications*** - *Asharaf S., Sivadas Neelima, Adarsh S., and Franklin John, Springer.*

SCHEME FOR EXAMINATION

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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

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M. Tech.-Computer Science
(Specialization-AI and Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks
COURSE NO: P2MTTE-325
COURSE TITLE: PATTERN RECOGNITION

Course Objectives & Learning Outcomes:

- To understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms
- To analyze and construct neural networks and kernel-based models for solving real-world pattern recognition tasks
- To explore and evaluate recent advancements and challenges in the field of pattern recognition
- Students will be able to apply the knowledge of feature extraction methods, feature evaluation, and data mining on real life
- Students will be able to apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data

UNIT-I Pattern Recognition
Types and components of Pattern Recognition System, Problem formulation (Classification, Regression, and Clustering).

(10 Hours)

UNIT-II Mathematical Foundations
Probability and Statistics (Random variables, Expectation, Variance, Covariance, Bayesian Decision Theory), Structural Pattern Recognition (Elements off or mal grammars-String generation as pattern Syntactic Description-Parsing-Stochastic grammars structural representation).

(10 Hours)

UNIT-III Feature Engineering
Techniques for extracting features from raw data (e.g., Fourier Transform, Wavelet Transform), Image features (Edge, Texture, Shape, Color Histograms), Entropy minimization-Karhunen-Loeve Transformation, Feature selection through Functions Approximation-Binary feature selection.

(10 Hours)

UNIT-IV Neural Networks and Kernel Machines
Neural network structures for (pattern recognition, pattern associates, Self organizing networks), Kernel machines (Support vector machines, Maximum margin classification, and generalize ability, Vapnik–Chervonenkis dimension).

(10 Hours)

UNIT-V Recent Trends and Challenges
Generative Models in Pattern Recognition, Multimodal Pattern Recognition, Challenges (Adversarial Attacks on Pattern Recognition Systems, Data Scarcity and Imbalanced problem, Privacy and Security in Pattern Recognition).

(10 Hours)

Suggested readings/ references:

1. ***Pattern Recognition and Machine Learning***- *Christopher M. Bishop, Springer.*
2. ***Deep Learning*** - *Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press.*
3. ***Pattern Classification*** - *Richard O. Duda, Peter E. Hart, and David G. Stork, Wiley-Interscience.*
4. ***Pattern Recognition*** - *Sergios Theodoridis and Konstantinos Koutroumbas, Academic Press.*
5. ***Machine Learning: A Probabilistic Perspective*** - *Kevin P. Murphy, MIT Press.*

SCHEME FOR EXAMINATION

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Total			**100**

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M. Tech. - Computer Science
(Specialization - AI & Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks
COURSE NO: P2MTTE-326
COURSE TITLE: NEURAL NETWORKS & FUZZY LOGIC

Course Objectives & Learning Outcomes:

- To provide a strong foundation in neural network architectures and learning algorithms
- To introduce fuzzy logic concepts and their application to engineering problems
- To enable students to apply soft computing techniques in intelligent systems
- Students will be able to design, implement, and train feed-forward and recurrent neural networks using real-world datasets
- Students will apply fuzzy rules and membership functions to handle uncertainty and imprecision in real-world scenarios

UNIT-I Neural Networks
Biological Neural Networks vs. Artificial Neural Networks, McCulloch-Pitts Neuron Model, Perceptron and Multilayer Perceptron, Activation Functions (Sigmoid, ReLU, Tanh), Learning Rules (Hebbian, Perceptron Learning, Delta Rule), Supervised vs. Unsupervised Learning

(10 Hours)

UNIT-II Algorithms and Architectures
Backpropagation Algorithm and Gradient Descent, Convergence and Optimization, Radial Basis Function Networks, Hopfield Networks, Self-Organizing Maps (Kohonen Networks), Associative Memory, Recurrent Neural Networks (RNN) basics

(10 Hours)

UNIT-III Advanced Neural Networks & Applications
Deep Neural Networks (DNNs) Overview, Convolutional Neural Networks (CNNs), Long Short-Term Memory Networks (LSTM), Applications in Image Processing, Natural Language Processing, Forecasting, Neural Networks in Control and Robotics, Tools & Libraries (TensorFlow, Keras, PyTorch)

(10 Hours)

UNIT-IV Fuzzy Logic
Crisp vs. Fuzzy Logic, Fuzzy Sets and Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations and Compositions, Fuzzy Rules and Inference Systems, Fuzzification and Defuzzification Methods

(10 Hours)

UNIT-V Fuzzy Rule-based Systems and Decision making
Fuzzy Control Systems, Fuzzy Decision Making, Adaptive Fuzzy Systems, Fuzzy Clustering (e.g., Fuzzy C-Means), Hybrid Systems (Neuro-Fuzzy Systems), Applications in Industrial Automation, Pattern Recognition, Decision Support Systems

(10 Hours)

Suggested readings/ references:

1. ***Neural Networks and Learning Machines-*** *S. Haykin, Pearson Education.*
2. ***Neural Networks: A Comprehensive Foundation-*** *Simon Haykin, Prentice Hall.*
3. ***Neural Networks, Fuzzy Logic and Genetic Algorithms*** *- S. Rajasekaran and G.A. Vijayalakshmi Pai, PHI.*
4. ***Fuzzy Logic with Engineering Applications*** *- Timothy J. Ross, Wiley.*
5. ***Neuro-Fuzzy and Soft Computing*** *- J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Prentice Hall.*

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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
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Total			**100**

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M. Tech.-Computer Science
(Specialization-AI and Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: P2MTTE-327

COURSE TITLE: APPLICATIONS OF AI & DATA SCIENCE

Course Objectives & Learning Outcomes:

- To introduce students to the fundamentals and applications of Bioinformatics in healthcare, biology, and agriculture using data science tools and techniques
- To enable students to perform Social Media Analytics by extracting, pre-processing, and analyzing data from various social media platforms for societal and business insights
- To equip students with knowledge of Generative AI, including various generative models and their applications in creative domains
- Students will be able to apply data science algorithms to analyze genomic and biomedical datasets
- Students will be able to evaluate real-world case studies demonstrating computational approaches in biological research

UNIT-I Bioinformatics

Data Science in Biology and Healthcare, Bioinformatics, Applications in biology, medicine, agriculture, Role of computer science in bioinformatics, DNA, RNA, Proteins, Genes and genomes, algorithms for bioinformatics data analytics, Real-world case studies

(10 Hours)

UNIT-II Social Media Analytics

Overview of Social Media Sites, Types of Data (posts, comments, hash tags, metadata), Social media's role in society, business, and politics, Handling missing or inconsistent data, Tokenization, stop words, stemming, Text classification (spam detection, topic classification)

(10 Hours)

UNIT-III Generative AI

Generative AI, Types of Generative Models, Probabilistic and Deep Learning-based Generative Models, Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), Diffusion Models, Training Challenges in GANs, Applications of Generative AI, AI for Creativity

(10 Hours)

UNIT-IV Data Science for Decision Making

Data-driven Decision Making, Role of data science in business and policy, Types of decisions: strategic, tactical, operational, Types of data (structured vs. unstructured), Data sources (surveys, web, sensors, databases, Visual storytelling with data)

(10 Hours)

UNIT-V Business Analytics

Basic Properties of time-series data, Distribution and moments, Stationarity, Autocorrelation, Heteroscedasticity, Normality, Autoregressive models and forecasting (AR, ARMA, ARIMA models). Random walk model (non-stationarity and unit-root process, Drift and Trend models), Regression analysis with time-series data using R programming.

(10 Hours)

Suggested Readings/ References:

1. ***Introduction to Bioinformatics*** – *Arthur M. Lesk, Oxford University Press.*
2. ***Advances in Social Network Analysis: Research in the Social and Behavioral Sciences*** – *Stanley Wasserman and Joseph Galaskiewicz, Sage Publications.*
3. ***Introductory Econometrics for Finance*** – *Chris Brooks, Cambridge University Press.*
4. ***Introduction to Operations Research*** – *F.S. Hillier and G.J. Lieberman, Tata McGraw Hill Education Private Limited.*
5. ***Data Mining for Business Analytics: Concepts, Techniques, and Applications in R*** – *Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, and Kenneth C. Lichtendahl Jr., John Wiley & Sons.*

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Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

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M. Tech.-Computer Science
(Specialization-AI and Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028
COURSE NO: P2MTTE-328
COURSE TITLE: THEORY OF COMPUTATION

Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

Course Objectives & Learning Outcomes:

- To introduce the foundational concepts of formal languages, automata theory, and grammars, including regular expressions and context-free grammars
- To understand the design and operation of computational models such as Finite Automata, Pushdown Automata, and Turing Machines
- To explore the theoretical limits of computation through recursive function theory, decidability and undecidability
- Students will be able to Design and analyze Turing machines for various computational problems and recognize the limits of algorithmic computation
- Evaluate problems in terms of decidability and apply recursive function theory to classify computational problems

UNIT–I Regular Languages and Expressions

Sets, Relations and Functions, Symbols, Alphabet, Strings, Backus-Naur Form, Languages, Grammar, Classification of Grammars, Regular Set, Regular expressions, Algebra of Regular expressions, Regular grammar, Regular languages, Closure properties of Regular languages, Applications of regular expressions.

(10 Hours)

UNIT–II Finite Automata

Deterministic Finite Automata (DFA) Non-Deterministic Finite Automata (NFA), ε-NFA, Equivalence Finite Automata, Equivalence of Regular Expression and Finite Automata, Pumping Lemma for Regular Languages, Applications of finite automata, Mealy and Moore Machines.

(10 Hours)

UNIT–III Context Free Grammar (CFG)

Production rules and derivation, Types of Productions, Reduction of Grammar, Chomsky Normal Form, Greibach Normal Form, Pushdown Automata (PDA), Equivalence between CFG and PDA, Context Free Language, Closure properties for context free languages, Pumping Lemma for Context free languages, Applications of Context Free Grammar.

(10 Hours)

UNIT–IV Turing Machines

Description, Transition diagram, Roles of Turing machine, Church-Turing Thesis, Modular Construction of complex Turing machines, Extensions of Turing machines, Non-Deterministic Turing Machines. Universal Turing Machine, Turing acceptable and Turing decidable languages.

(10 Hours)

UNIT–V Function Theory

Recursive Function Theory and Unsolvable Problems Partial, total and constant functions, Primitive recursive functions; Unbounded minimalization and μ-recursion.

Decidable and Undecidable Problems, The Halting Problem, Reduction to Another Undecidable Problem, Undecidability of Post Correspondence Problem.

(10 Hours)

Suggested Readings/ References:

1. ***Elements of the Theory of Computation*** – H. R. Lewis and C. H. Papadimitriou, Prentice Hall of India.
2. ***Introduction to Automata Theory, Languages and Computation*** – J. E. Hopcroft, R. Motwani, and J. D. Ullman, Pearson Education Asia.
3. ***Introduction to the Theory of Computation*** **(Second Edition)** – Michael Sipser, Thomson.
4. ***Theory of Computations (Automata, Languages and Computation)*** – K. L. P. Mishra and N. Chandrasekaran, Prentice Hall.
5. ***Theory of Recursive Functions and Effective Computability*** – Rogers H., McGraw-Hill.
6. ***Introduction to Languages and Theory of Computation*** – J. C. Martin, Tata McGraw Hill.
7. ***An Introduction to Formal Languages and Automata*** – P. Linz, Narosa.
8. ***Automata and Computability*** – D. C. Kozen, Springer.

SCHEME FOR EXAMINATION

The students shall be continuously examined/evaluated during the conduct of each course of the semester. The following scheme shall be used for the evaluation of the performance of a student:

Written Test/Presentation/ Mini Project (*)	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MINOR-I (after 1 $^1/_2$months)	25%	1 hour(**)	20
MINOR- II (after2 $^1/_2$months)	25% (syllabus taught during this period)	1 hour(**)	20
Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

*It shall be mandatory for the concerned teacher to conduct any 1 of the two minors (Minor-I/ Minor-II) in the mode of written exam.

**In case MINOR-I examination is conducted in the form of mini project/ presentation, the time duration shall be as per the instructions of the teacher in-charge.

Instructions for Paper Setting

MINOR-I and II: There shall be 5 short answer type questions each carrying 2 marks and 2 long answer type questions each carrying 5 marks. All questions in this test shall be compulsory.

MAJOR: There shall be 2 sections in this question paper.

- **Section- A** shall consist of 5 short answer type questions each carrying 4 marks spread over the entire syllabus. All questions in this section shall be compulsory.
- **Section-B** shall consist of total of 8 questions carrying 8 marks each. The student shall be required to attempt 5 questions out of 8. There shall be 1 question each from UNIT I and II in this paper and there shall be 2 questions each from the rest of the Units (UNIT-III, IV and V).

M. Tech.-Computer Science
(Specialization-AI and Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028
Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks
COURSE NO: P2MTTE-329
COURSE TITLE: NETWORK SECURITY AND CRYPTOGRAPHY

Course Objectives & Learning Outcomes:

- To introduce the mathematical foundations of cryptography and the need for secure communication through various security standards and techniques
- To understand symmetric and asymmetric key cryptography methods, encryption algorithms, cryptanalysis, and secure key exchange protocols
- To explore authentication mechanisms, digital signatures, and hash functions used in securing digital communications and services
- Students will be able to analyze and compare symmetric and asymmetric encryption schemes, and evaluate their strengths, weaknesses, and vulnerabilities
- Implement authentication protocols and digital signature techniques to ensure secure communication, integrity, and authenticity in digital systems

UNIT-I Cryptography Fundamentals
Mathematical Foundation, Modular arithmetic, totient function, Fermat's and Euler's theorems, one-way and invertible functions, Euclid's algorithm, Galois Field (2^n), FIPS and NIST security standards, Encryption & Decryption, Cryptanalysis techniques.
Need for security, Security Trends, Security Attacks, Security Service.

(10 Hours)

UNIT-II Symmetric Key Cryptography
Private key, Block Ciphers: Modes of Operation, Data Encryption Standard (DES), Double DES, Triple DES, International Data Encryption Algorithm (IDEA), Advanced Encryption Standard (AES), Rijndael Algorithm, Twofish, Blowfish, RC2, RC5, Stream Ciphers, RC4, One Time Pads.

(10 Hours)

UNIT-III Asymmetric Key Cryptography
Public Key vs. Private Key Encryption, Public Key Cryptosystems, Rabin Cryptosystem, ElGamal Cryptosystem, Knapsack Cryptosystem, RSA Algorithm.
Asymmetric Cryptosystems attacks, Brute-Force Attacks, Mathematical Attacks, Side-Channel Attacks.
Optimal Asymmetric Encryption Padding (OAEP), Elliptic Curve Cryptography (ECC).

(10 Hours)

UNIT-IV Authentication Protocol
Authentication Fundamentals, Authentication using Symmetric Key Cryptography and Asymmetric Key Cryptography, Reflection Attack, Man-in-the-Middle Attack, Replay Attacks, Denial of Service (DoS) and Distributed Denial of Service (DDoS) Attacks, Zero Knowledge Protocol, Diffie-Hellman Key Exchange, Key Distribution Center (KDC), Kerberos Protocol, X.509 Directory Authentication Service, Pretty Good Privacy (PGP), Secure/Multipurpose Internet Mail Extensions (S/MIME).

(10 Hours)

UNIT-V Digital Signature
Importance and Applications, Hash Functions in Cryptography, Secure Hash Algorithm (SHA), Message Digest Algorithms (MD5, SHA-1, SHA-256), HMAC (Hash-based Message Authentication Code), HMAC Specifications, Digital Signature Standards (DSS), RSA Digital Signature, Digital Signature Attacks, Applications in Secure Communication and Authentication.

(10 Hours)

Suggested readings/ references:

1. ***Cryptography and Network Security: Principles and Practice*** – *William Stallings, Pearson Education.*
2. ***Cryptography Engineering: Design Principles and Practical Applications*** – *Niels Ferguson, Bruce Schneier, and Tadayoshi Kohno, Wiley.*
3. ***Cryptography and Network Security*** – *Behrouz A. Forouzan, McGraw-Hill Education.*
4. ***Network Security Essentials: Applications and Standards*** – *William Stallings, Pearson Education.*
5. ***Cryptography and Network Security*** – *Atul Kahate, Tata McGraw-Hill Education.*

SCHEME FOR EXAMINATION

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MINOR- II (after2 $^1/_2$months)	25% (syllabus taught during this period)	1 hour(**)	20
Theory	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**%Weightage (Marks)**
MAJOR Exam (after 4 months)	100%	3 hours	60
Total			**100**

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M. Tech. - Computer Science
(Specialization - AI & Data Science)

Semester-III

Total Marks = 100
No. of Credits = 4
Time for Minor Exam = 1 hour
Time for Major Exam = 3 hours
Examination to be held: December 2026, 2027, 2028

Minor Exam I = 20 Marks
Minor Exam II = 20 Marks
Major Exam = 60 marks

COURSE NO: P2MTTE-330

COURSE TITLE: CLOUD COMPUTING AND INTERNET OF THINGS

Course Objectives & Learning Outcomes:

- To study the fundamental concepts of cloud computing, enabling technologies, cloud service models and security concerns
- To learn core issues of Internet of Things, IOT communication protocols and security concerns
- To learn the integration of IoT systems with cloud platforms
- Students will be able to apply cloud computing concepts like virtualization, service models, and security in real-world systems.
- Students will be able to design IoT systems using communication protocols, hardware platforms, and cloud integration.
- Students will be able to analyze and apply cloud-based services and platforms for computing, storage, and networking

UNIT-I Cloud Computing

Principle of Cloud computing, Characteristics and Architecture, Deployment Models, Service Models. Virtualization (Benefits & Drawbacks), Server Virtualization, Virtualization of (Operating System, Platform, CPU, Network, Application, Memory and I/O Devices), Resource Pooling, prioritizing, Sharing and Provisioning, Load Balancing.

(10 Hours)

UNIT-II Cloud Services

Cloud Computing Service Platforms, core cloud services, advanced cloud service (application services, queuing services, e-mail services, notification services, media services, content delivery services, analytics services, deployment & management services, identity & access management services), Security in cloud computing.

(10 Hours)

UNIT-III Internet of Things (IoT)

Design principles for connected devices, Modified OSI Model for IoT/M2M systems, ETSI M2M Domains and High-level capabilities, Wireless Communication Technologies (NFC, RFID, Bluetooth low energy, ZigBee, WiFi, RF transceiver and RF modules). Single Board Computers and Microcontrollers (Raspberry Pi, Arduino, Beagle Bones), IoT Sensors and Actuators.

(10 Hours)

UNIT-IV Web Communication for IoT

Design principles for Web Connectivity: Web Communication Protocols for connected devices: Constrained Application Protocol (CoAP), CoAP Client, web connectivity, client authentication, lightweight M2M communication protocol. Message communication protocols for connected devices – CoAP-SMS, CoAP-MQ, MQTT, XMPP, IoT Security issues and Threats.

(10 Hours)

UNIT-V Cloud IoT Architecture

IoT Cloud Platforms Overview, core services of (Google, AWS, Azure IoT), Thingspack Server, IoT Analysis Platform Services, Choosing the right IoT Cloud Platform (for Business & Technical considerations), Data Enrichment, Data Consolidation and Device Management at gateway.

(10 Hours)

Suggested readings/ references:

1. ***The Internet of Things – Key Applications and Protocols***, *Olivier Hersent, David Boswarthick, Omar Elloumi, Wiley.*
2. ***Cloud Computing: A Practical Approach***, *Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, McGraw-Hill.*
3. ***Cloud Computing: Principles and Paradigms***, *Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley.*
4. ***Introduction to Sensors in IoT and Cloud Computing Applications***, *Ambika Nagaraj, Bentham Books.*
5. ***Internet of Things: A Hands-On Approach***, *Arshdeep Bahga, Vijay Madisetti, VPT.*

SCHEME FOR EXAMINATION

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M. Tech.-Computer Science
(Specialization - AI and Data Science)

Semester-III

Total Marks = 150
No. of Credits = 6
Examination to be held: December 2026, 2027, 2028
Internal Evaluation = 75 Marks
External Evaluation = 75 Marks
COURSE NO: P2MTPC-380
COURSE TITLE: PYTHON / IBM MODELER/WEKA

For examinations to be held in Dec- 2026, 2027, and 2028

This Practical course shall be primarily based on Python, IBM modeler/WEKA. The course carries 150 marks distributed as follows:

Practical			**Marks**	
Internal Evaluation	I	Program Implementation & Viva-Voce	65	75
	II	Practical File	10	
External Evaluation				75
Total				**150**

Internal Evaluation

Guidelines for internal Assessment of practical courses

- Performance of the students will be evaluated based on a comprehensive system of continuous evaluation.
- For each practical course, students will be given regular assignments by the concerned practical teacher(s).
- The Implementation of assignments will be assessed & evaluated and viva-voce will be conducted at least once in every fifteen days and the students shall be awarded based on their performance.
- Record of the internal evaluation shall be maintained regularly by the concerned teacher(s).
- At the end of the semester all the awards of the students shall be consolidated for the purpose of preparing the final award of the Internal Evaluation.

External Evaluation

The External practical evaluation shall be conducted by an external examiner. The internal practical teacher in charge shall coordinate the conduct of the external practical examination.

M. Tech.-Computer Science
(Specialization - AI and Data Science)
Semester-III

Total Marks = 50
No. of Credits = 2
Examination to be held: Dec 2026, 2027, 2028
COURSE NO: P2MTRC-310
COURSE TITLE: DISSERTATION (PHASE-I)

For examinations to be held in Dec- 2026, 2027, and 2028

In this course, the students shall be exposed to the emerging areas of research in the field of Computer Science & IT (AI, Data Science, Machine Learning, Cyber Security, Computer Vision and many other emerging areas). The students shall be required to explore various technologies and techniques used for undertaking research. They will undergo an extensive study of various research papers in their area of interest in which they have gained expertise during the previous semesters of M. Tech Program. The students shall gain enough experience and understanding of the need and scope of research in the field of Computer Science along with its applications in various domains.

Based on the interest generated during the previous two semesters the student will select or choose a topic of his/her interest for pursuing research in the fourth and final semester of M.Tech. Programme. The students shall also work out the details of the research which he/she shall be undertaking during this semester course. A formal document describing the details of research proposal shall be prepared by the students in the form of a synopsis and shall be submitted into the department for approval by the concerned committee.

a) Guidelines for preparing Synopsis

- Each candidate should work independently on a chosen topic of research under the guidance of a teacher (Guide/Supervisor) allotted to the candidate by Dissertation Committee constituted by the department.
- Students shall study a significant number of research papers in the area of interest and should regularly be in-touch with the supervisor allocated.
- The student will prepare and submit the synopsis of the research work at the end of the semester to the department.
- After the submission of synopsis, the students shall have to make a presentation of the synopsis work, before the Dissertation Committee for final approval.

b) Format for preparing the synopsis

Title of the Research Work
i. Introduction
ii. Theory/Problem Statement
  a. Background/ Literature Review
  b. Hypothesis Testing (if any)
iii. Expected Contribution of the study
  a. Justification
  b. Objectives
iv. Research Methodology
v. References

EVALUATION CRITERIA

The performance/evaluation of competence of students w.r.t undertake Research Work in the 4th semester shall be assessed during the time of presentation of the synopsis before the dissertation committee submitted in this semester.

The students shall be awarded **out of total 50 marks** during the presentation before the dissertation committee.

M. Tech.-Computer Science

(Specialization - AI and Data Science)

Semester-IV

Total Marks = 500	
No. of Credits = 20	Internal Evaluation = 200 Marks
Examination to be held: May 2027, 2028, 2029	External Evaluation = 300 Marks
COURSE NO: P2MTRC-401	
COURSE TITLE: DISSERTATION (PHASE-II)	

For examinations to be held in Dec- 2026, 2027, and 2028

To ensure the quality and academic integrity of the M. Tech. dissertation work, all students are expected to follow a structured process throughout the final phase of the Dissertation work. The following guidelines have been established to provide clarity on the expectations, timelines, and necessary academic deliverables associated with the dissertation work. Adherence to these guidelines shall ensure successful completion and submission the M.Tech. dissertation work.

Guidelines for preparing Dissertation:

i. The student shall continue the M.Tech. dissertation work based on prior work and the approved synopsis.
ii. The progress of the dissertation work shall be continuously monitored by concerned Guide/Supervisor.
iii. There will be a midterm presentation of the dissertation work before the members of the Dissertation Committee.
iv. After the completion of the semester the students have to submit a report of the work done in the form of a Dissertation duly authenticated by the allocated Supervisor.
v. The students are required to complete his/her M. Tech. dissertation work as per the satisfaction of the supervisor and Dissertation committee within a period of 4 to 6 months from the date of commencement of the semester.
vi. The student is required to publish (or at least submit) one research paper in Reputed/Refereed/Peer reviewed/indexed Journals before the final submission of the dissertation.

The dissertation may be prepared and arranged in the sequence consisting of the following:

(a) Top Sheet of transparent plastic
(b) Top cover
(c) Preliminary pages
  i. Title page
  ii. Certification page
  iii. Certificate by the Guide
  iv. Acknowledgment
  v. Abstract
  vi. Table of Contents
  vii. List of Figures/Photographs and Tables
(d) Chapters
(e) Appendices, if any
(f) References

Evaluation	Marks	Mode of evaluation
Internal	200	Evaluation shall be made on the basis of nid term presentation of project work before the Dissertation committee
External	300	Evaluation shall be made on the basis of the Dissertation submitted by the students and VIVA conducted by the external examiner
Total	**500**	

Annexure-D

B. A. / B. Sc. Honours

IN

COMPUTER APPLICATIONS

SYLLABUS

Revised Syllabus, 2025
(NEP-2020)

Four Year Undergraduate Programme

As per NEP 2020 guidelines

Under Choice based Credit System

FOR THE STUDENTS TO BE ADMITTED IN THE SESSIONS
2025-26, 2026-27, 2027-28